
Spatial Variability of Available Nutrients in Soil in Nearly Level Fields in Northeastern Saskatchewan

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Background and Objective

Most farm fields have landscape units. It is well known that field units based on landscape positions are highly variable in nutrient levels (particularly N) and yield potentials. Thus, these landscape units have different requirements for fertilizers and other inputs. The spatial distribution patterns of soil properties can also be affected by minor changes in relief within short distances. The purpose of this study was to determine spatial variations, over very short distances in nearly level fields, in plant-available N, P, K and S in northeastern Saskatchewan.

Materials and Methods

<i>Location:</i>	Sylvania and Star City, Saskatchewan
<i>Previous Management:</i>	Sylvania - Summerfallow in 1996, Star City - Cereal stubble
<i>Slope:</i>	Sylvania - nearly level Star City - very gentle slop to north
<i>Soil/Region:</i>	Parkland Region (Gray Luvisol soils)
<i>Plot Size:</i>	1.5 m x 7.0 m
<i>No. of Plots:</i>	88
<i>Time of Soil Sampling:</i>	Soil cores from the centre of each plot (0-15, 15-30 and 30-60 cm depths) in the spring of 1997
<i>Data Collected:</i>	Nitrate-N, Extractable P, K and S, and Total Organic Matter

Summary of Results

- ❖ The magnitude of variation (especially for nitrate-N and SO₄-S) was much larger in the summerfallow soil at Sylvania than the cereal stubble soil at Star City.
- ❖ At Sylvania, the concentration of nitrate-N in soil ranged between 13-87 mg N kg⁻¹ in 0-15 cm, 9-35 mg N kg⁻¹ in 15-30 cm, and 2-21 mg N kg⁻¹ in 30-60 cm depths (Tables 1, 2 and 3).
- ❖ The concentration of other plant-available nutrients in the 0-15 cm soil depth varied from 3-13 mg P kg⁻¹ for P (Table 4), 110-240 mg K kg⁻¹ for K (Table 5), 1-22 mg S kg⁻¹ for S (Tables 6, 7 and 8), and 30-63 g kg⁻¹ for Total organic matter (Table 9).

- ❖ At Star City cereal stubble site), the concentration of nitrate-N in soil ranged between 4-8 mg N kg⁻¹ in 0-15 cm , 2-5 mg N kg⁻¹ in 15-30 cm, and 1-3 mg N kg⁻¹ in 30-60 cm depths.
- ❖ The concentration of other plant-available nutrients at Star City in the 0-15 cm soil depth varied from 5-15 mg P kg⁻¹ for P, 180-290 mg K kg⁻¹ for K, and 5-7 mg SO₄-S kg⁻¹ for S.

Conclusions

- ❖ The results have shown large spatial variations in the summerfallow soil for some agronomically important soil properties in nearly level fields.
- ❖ Further research is needed on how to manage these soil variations to apply fertilizers cost-effectively on nearly level fields.

Table 1. Nitrate-N (mg N kg⁻¹) in the 0-15 cm soil in a nearly level summerfallow field at Sylvania in northeastern Saskatchewan

Rep 4	54	48	53	56	64	60	59		26	84	56	36	55	37	63	19	69	58	38		48	48
Rep 3		45			51	62	66	61	31	64	44	36	46	38	58		46	62	39	59	67	44
Rep 2	72	48	60	87	56	63	50	60	66	46	57	47			51	60	55	49	48	65	63	
Rep 1	77	24	49	57	13	15	33	56	75	56	63	62	59		57	55	57	52	52	56	48	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Table 2. Nitrate-N (mg N kg⁻¹) in the 15-30 cm soil in a nearly level summerfallow field at Sylvania in northeastern Saskatchewan

Rep 4	29	22	33	21	28	16	22		15	26	23	25	25	25	23	26	20	26	19		22	19
Rep 3	29	22		19	19	32	23	21	19	14	19	12	18	11	22		18	17	8.6	13	20	17
Rep 2	24	12	24	24	25	24	24	24	35	18	23	21			21	17	17	30	13	15		24
Rep 1	12	27	28	19	23	24	21	23	24	22	16	23	33		20	27	22	16	23	17	22	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Table 3. Nitrate-N (mg N kg⁻¹) in the 30-60 cm soil in a nearly level summerfallow field at Sylvania in northeastern Saskatchewan

Rep 4	5.2	9.6	8.6	9.0	12.0	7.2	12.0		9.2	11.0	14.0	6.4	4.4	5.0	9.2	8.0	11.0	13.0	7.6		5.0	6.2
Rep 3	12.0	15.0		6.8	11.0	13.0	11.0	7.2	8.2	13.0	5.3	9.6	10.0	11.0	15.0		5.0	5.5	1.7	5.5	15.0	8.6
Rep 2	9.4	10.0	9.6	13.0	12.0	11.0	8.4	12.0	14.0	4.8	16.0	7.0			8.8	5.4	13.0	21.0	4.2		9.8	14.0
Rep 1	11.0	6.0	11.0	7.8	4.6	8.0	8.4	8.8	10.0	9.8	6.4	9.0	8.6		12.0	13.0	9.6	11.0	10.0	12.0	11.0	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Table 4. Extractable P (mg P kg⁻¹) in the 0-15 cm soil in a nearly level summerfallow field at Sylvania in northeastern Saskatchewan

Rep 4	10.0	9.8	8.2	7.3	9.5	6.4	6.0		5.9	7.3	7.0	10.0	7.8	6.0	6.0	8.0	8.0	3.9	5.6		3.4	6.7
Rep 3		8.6			6.6	7.5	5.6	6.1	2.8	4.1	11.0	6.7	13.0	11.0	11.0		8.5	7.4	6.2	6.7	6.0	7.3
Rep 2	8.8	7.1	9.0	10.0	7.2	5.1	9.8	7.7	11.0	13.0	9.2	9.0			10.0	8.4	5.6	5.2	6.3	5.8	7.8	
Rep 1	8.7	8.9	7.1	6.5	7.7	8.4	4.9	9.0	8.5	6.2	9.6	11.0	10.0		6.9	8.3	7.7	4.4	5.7	5.1	7.7	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Table 5. Extractable K (mg K kg⁻¹) in the 0-15 cm soil in a nearly level summerfallow field at Sylvania in northeastern Saskatchewan

Rep 4	190	130	140	120	130	120	110		150	170	160	180	190	160	180	150	160	190	120		170	190
Rep 3		140			160	140	170	170	160	170	210	170	240	200	210		180	190	120	180	160	180
Rep 2	140	140	150	130	130	130	130	150	160	180	180	160			130	180	160	150	170	170	160	
Rep 1	140	140	150	140	120	170	160	160	140	140	140	160	180		160	170	140	140	140	110	110	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Table 6. Sulphate S (mg S kg⁻¹) in the 0-15 cm soil in a nearly level summerfallow field at Sylvania in northeastern Saskatchewan

Rep 4	6.0	6.6	7.0	5.6	8.0	8.2	7.4		5.2	7.4	6.8	7.0	6.8	5.4	6.2	6.2	8.0	7.6	6.8		6.6	7.0
Rep 3		7.0			7.4	9.8	10.0	6.8	5.8	8.0	8.4	8.2	8.2	6.7	9.6		7.7	9.6	8.4	8.6	8.4	6.2
Rep 2	7.8	6.8	7.4	8.8	8.0	22.0	11.0	20.0	7.4	1.2	6.2	7.4			8.2	7.8	7.6	5.8	6.6	8.2	5.8	
Rep 1	8.8	10.0	7.8	7.4	8.2	19.0	7.8	8.2	9.6	9.0	8.0	9.6	9.6		7.8	9.2	9.2	8.4	8.4	8.2	6.6	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Table 7. Sulphate S (mg S kg⁻¹) in the 15-30 cm soil in a nearly level summerfallow field at Sylvania in northeastern Saskatchewan

Rep 4	4.2	2.2	3.2	5.4	3.2	7.2	4.4		3.4	3.0	3.8	3.2	3.4	3.2	3.2	3.4	3.2	3.2	4.0		3.4	4.2
Rep 3	4.6	3.0		3.6	4.0	4.0	4.2	4.2	3.4	9.1	5.8	3.1	3.8	2.9	4.1		3.6	3.1	3.4	2.9	3.1	3.8
Rep 2	2.6	3.4	4.4	3.6	9.0	21.0	5.2	6.0	57.0	3.0	4.0	3.4			3.2	3.8	2.8	4.0	4.8	3.4		7.0
Rep 1	6.0	6.6	4.4	3.6	5.8	6.6	3.6	6.6	4.8	5.8	3.2	3.6	4.6		5.0	5.2	4.6	4.2	4.0	3.2	4.4	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Table 8. Sulphate S (mg S kg⁻¹) in the 30-60 cm soil in a nearly level summerfallow field at Sylvania in northeastern Saskatchewan

Rep 4	2.0	2.2	1.4	3.8	3.0	17.0	7.4		2.4	2.8	4.2	2.4	1.0	1.0	2.4	2.4	1.8	3.6	2.6		2.2	2.4
Rep 3	2.2	2.6		2.0	79.0	6.8	18.0	15.0	7.6	6.0	3.4	2.2	2.2	4.1	3.6		5.5	2.2	12.0	2.9	3.1	4.6
Rep 2	3.0	4.0	6.6	5.0	11.0	12.0	16.0	6.0	3.4	1.0	4.2	2.0			2.8	2.8	3.6	5.4	13.0		6.0	18.0
Rep 1	22.0	12.0	3.4	4.4	26.0	6.6	5.6	4.6	15.0	9.6	3.8	2.6	2.8		3.0	4.0	4.8	4.6	5.2	31.0	3.8	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Table 9. Total organic matter (g kg^{-1}) in the 0-15 cm soil in a nearly level summerfallow field at Sylvania in northeastern Saskatchewan

Rep 4	34	34	44	33	34	30	34		34	49	43	57	41	33	42	60	35	49	42		43	49
Rep 3		38			34	58	37	44	34	30	51	49	59	55	59		51	56	51	45	46	43
Rep 2	53	48	63	59	56	54	54	54	47	46	53	59			57	39	39	42	42	46	51	
Rep 1	53	56	51	55	48	58	48	54	52	47	62	54	54		61	42	41	40	42	41	46	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22